

We claim:

1. A sunscreen composition comprising:
  - a) a carotenoid or a carotenoid derivative having sunscreen activity;
  - b) a polyphenolic compound or a polyphenolic compound derivative having sunscreen activity;
  - c) a light absorbing amino acid having sunscreen activity or a light absorbing amino acid derivative having sunscreen activity; and
  - d) a carrier.
2. The composition of claim 1, wherein the carrier comprises water, a gas, a water-based liquid, an oil, a gel, an emulsion, an oil-in-water emulsion, a water-in-oil emulsion, a dispersion or a mixture thereof.
3. The composition of claim 1 or 2, wherein the carotenoid comprises a cyanobacterial carotenoid.
4. The composition of any of claims 1 to 3, wherein the carotenoid comprises a compound selected from the group consisting of  $\beta$ -carotene, lutein, neoxanthin, zeaxanthin, violaxanthin, antheraxanthin, caloxanthin, nostoxanthin, echinenone, canthexanthin, oscillaxanthin and myxoxanthophyll.
5. The composition of any of claims 1 to 4, wherein the polyphenolic compound is a cyanobacterial polyphenolic compound.
6. The composition of any of claims 1 to 5, wherein the polyphenolic compound comprises scytonemin.
7. The composition of any of claims 1 to 6, wherein the amino acid comprises a mycosporine amino acid.
8. The composition of claim 7, wherein the mycosporine amino acid comprises a compound selected from the group consisting of mycosporine-glycine, palythine, asterina-330, palythanol, palythene, porphyra-334, mycosporine-glycine:valine and shinorine.

AMENDED SHEET

27-12-2000

PCT/CA99/00981

GLMS

9. The sunscreen composition of any of claims 1 to 8, further comprising at least one cosmetically acceptable adjuvant or additive.
10. The composition of claim 9, wherein the adjuvant or additive comprises a preservative, organic solvent, browning agent, antioxidant, stabilizer, emollient, silicone, alpha-hydroxy acid, demulcent, anti-foaming agent, moisturizing agent, vitamin, fragrance, ionic or nonionic thickener, surfactant, filler, thickener, sequestrant, polymer, propellant, alkalinizing or acidifying agent, opacifier, fatty compound or colorant.
11. The composition of any of claims 1 to 10, comprising a nonionic vesicle dispersion, emulsion, cream, milk, gel, ointment, suspension, dispersion, powder, solid stick, foam or spray.
12. The composition of any of claims 1 to 11, selected from the group consisting of a makeup and a personal care product.
13. The composition of any of claims 1 to 12, comprising an anhydrous or aqueous solid or paste.
14. The composition of any of claims 1 to 12, comprising a hair rinse, spray, mist, gel, mousse, shampoo, conditioner, lotion, emulsion and colouring product.
15. A method of protecting human skin human hair or another surface from solar radiation, comprising topically applying thereto an effective amount of the composition of any of claims 1 to 12.
16. A sunscreen composition comprising a carrier and an effective amount of a heteroautotrophic cell extract or a photoautotrophic cell extract, the extract having sunscreen activity, the cells having been cultured under conditions of high excitation pressure.
17. The composition of any of claims 1 to 12 or claim 16, wherein the carrier is at least one of either water, a gas, a water-based liquid, an oil, a gel, an emulsion, a dispersion or a mixture thereof.
18. The sunscreen composition of claim 16 or 17, wherein the extract is present in an amount of about 0.1 to 25% by weight.
19. The sunscreen composition of claim 16 or 17, wherein the extract is present in an amount of about 0.1 to 10% by weight.
20. A personal care product comprising the composition of any of claims 1 to 19.

AMENDED SHEET

27-12-2000

PCT/CA99/00981

GLMS

21. A sunscreen composition comprising a photoautotrophic cell extract and a carrier, wherein the photoautotrophic cell extract is obtained by extraction of photoautotrophic cells with methanol and acetone.
22. A kit for assaying a test compound to determine its sunscreen efficacy, comprising: a photoautotrophic cell culture, a chlorophyll fluorometer and an artificial filter for containing the test compound.
23. A method for protecting the human skin, human hair or another surface from solar radiation, comprising topically applying thereto an effective amount of the sunscreen composition of any of claims 22 to 26.
24. A method of inducing a photoautotrophic cell or heterotrophic cell to produce a compound for absorption of solar radiation, the method comprising culturing the cell under conditions of high excitation pressure.
25. The method of claim 24, wherein the conditions of high excitation pressure comprise increased light and/or decreased temperature.
26. The method of claim 25, wherein the compound is selected from the group consisting of: a carotenoid, a carotenoid derivative having sunscreen activity, a polyphenolic compound, a polyphenolic compound derivative having sunscreen activity, a light absorbing amino acid having sunscreen activity and a light absorbing amino acid derivative having sunscreen activity
27. The method of claim 26, wherein the cell is a cyanobacterium.
28. The method of claim 27, wherein the compound for absorption of solar radiation is selected from the group consisting of myxoxanthophyll, scytonemin and/or mycosporine amino acid.
29. A sunscreen composition, comprising at least one compound of claim 26 or 28.
30. A method of producing an extract having an increased concentration of at least one of myxoxanthophyll, scytonemin and/or mycosporine amino acid, the method comprising:
- a) culturing cyanobacteria under conditions of high excitation pressure; and
  - b) isolating an extract including at least one of myxoxanthophyll, scytonemin and mycosporine amino acid.

AMENDED SHEET

09830193-011602

Sub  
A

4/12-2000

PCT/CA99/00981

CLMS

31. The method of claim 24 or claim 30, wherein conditions of high excitation pressure comprise: about 5 °C and a light intensity of about 150  $\mu\text{mol m}^{-2} \text{s}^{-1}$  or about 29 °C and a light intensity of about 750  $\mu\text{mol m}^{-2} \text{s}^{-1}$ .
32. The method of claims 24 to 31, further comprising isolating at least one of myxoxanthophyll, scytonemin and/or mycosporine amino acid.
33. A method of determining the sunscreen activity of an extract, comprising: extracting photoautotrophic cells to produce a solution; producing an aqueous filter; determining whether the aqueous filter protects photosystem I or II from UV radiation wherein improved protection from UV radiation indicates that the compound has sunscreen activity.
34. The method of claim 33, wherein the protection of photosystem II photochemical efficiency from UV radiation is determined by measuring chlorophyll a fluorescence.
35. A method for protecting human eyes from solar radiation, comprising applying at least one of a carotenoid, a polyphenolic compound and/or a mycosporine amino acid or a derivative of a carotenoid, a polyphenolic compound or a mycosporine amino acid to an eye wear lens or a window.
36. A method of reducing degradation of a chemical that is sensitive to ultraviolet light comprising applying the composition of claim 1 to the chemical.
37. The method of claim 36, wherein the chemical comprises a herbicide, a pesticide, an auxin, a gibberellin, abscisic acid, a cytokinin, derivative of a carotenoid, a polyphenolic compound, a mycosporine amino acid and or a derivative of any of the foregoing.
38. The composition of claim 1, wherein the amino acid or amino acid derivative is selected from the group consisting of tyrosine, tryptophan, a tyrosine derivative having sunscreen activity and a tryptophan derivative having sunscreen activity.
39. A system for determining the sunscreen activity of a test compound comprising:
- a) light means for generating ultraviolet radiation;
  - b) container means, coupled to the light means, for containing a photoautotrophic bacterial culture, homogenate or extract thereof having PSI or PSII activity; and

09230193:011602

SubA

27-12-2000

CLMS

c) sample means for holding a test compound, interposed between the light means and the container means.

40. The system of claim 39, further comprising a scoring means for assaying the culture, homogenate or extract to determine PSI or PSII activity, wherein the amount of decrease in PSI or PSII activity caused by ultraviolet radiation indicates the lack of sunscreen activity of the test compound.
41. A method for determining the sunscreen activity of a test compound comprising the steps of:
- (a) generating ultraviolet radiation for passing through the test compound;
  - (b) exposing a photoautotrophic bacterial culture, homogenate or extract thereof having PSII activity to the ultraviolet radiation being passed through the test compound;
  - (d) assaying the culture, homogenate or extract for PSI or PSII activity; and
  - (e) correlating the PSI or PSII activity to the sunscreen activity of the test compound.
42. The method of claim 41, further comprising determining the sun protection factor of the test compound.
43. A method for reducing ultraviolet light damage to a surface, comprising applying to the surface an effective amount of an extract from a photoautotroph, wherein the extract has sunscreen activity.
44. The method of claim 43, wherein the photoautotroph is selected from the group consisting of photoautotrophic bacteria, photoautotrophic plants, photoautotrophic fungi or heteroautotrophic bacteria.
45. The method of claim 43, wherein the surface comprises skin.
46. The method of claim 43, wherein the extract comprises at least one compound selected from the group consisting of: a carotenoid, a carotenoid derivative having light absorption activity, a polyphenolic compound, a polyphenolic compound derivative having light absorption activity, a light absorbing amino acid and a light absorbing amino acid derivative.

AMENDED SHEET

36